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Originals

Systematic Studies of Asian *Aconitum* (Ranunculaceae) VIII. Subgenus Tangutica, the Forth New Subgenus of the Genus *Aconitum* and a New Species Belonging to the Subgenus Tangutica

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Aconitum species which have scapose to subscapose habit, branched perennial rootstocks, non-tubular nectary blades in the distal part and navicular to conical helmets are regarded to belong to a subgenus, Tangutica (W.T.Wang) Kadota, which is regarded as the forth subgenus in the genus *Aconitum*. Within the subgenus Tangutica three sections are recognized; sect. Fletcherum Tamura, sect. Tangutica and sect. Zeravschanica Kadota. Sect. Fletcherum is emended and Sect. Zeravschanica is newly described in this paper. *Aconitum qinghaiense* is described from China as a member of subgenus Tangutica sect. Tangutica. (Continued from J. Jpn. Bot. **76**: 20–27, 2001)

Key words: *Aconitum qinghaiense*, new taxa, sect. Fletcherum, sect. Zeravschanica, subgenus Tangutica

Aconitum tanguticum was first published by Maximowicz (1899) as '*A. rotundifolium* Kar. & Kir. var. *tanguticum* Maxim.' Later Stapf (1905) recognized this entity to be a distinct species and published a new name *A. tanguticum* (Maxim.) Stapf. I agree Stapf's treatment because these two species, *A. tanguticum* and *A. rotundifolium*, are different in the shape of nectary spurs (Kadota 1998). Furthermore there is a significant difference in root system: *A. rotundifolium* has biennial tubers (mother tuber plus daughter tuber) while *A. tanguticum*, at least its lectoparatype specimens, has a perennial rootstock (Przewalski 307, LE!; Kadota 1998, fig. 1-C). *Aconitum tanguticum* is a small scapose plant and grows in rocky alpine meadows. Owing to difficulty to dig the rootstocks the specimens often do not have subterranean organs.

Aconitum species having perennial rhizomes have been calssified into subgenus Lycoctonum (e.g., Lauener and Tamura 1979, W.T.Wang 1979, Tamura 1995) [or a distinct genus, *Lycoctonum* (e.g., Nakai 1953)]. Then does *A. tanguticum* belong to subgenus Lycoctonum? Most members of subgenus Lycoctonum have helmets higher than broad. In the case of the species with helmets broader than tall, the helmets are provided with long anterior parts (e.g., *A. novoluridum* Munz; Lauener and Tamura 1979, fig. 1-C). *Aconitum tanguticum* has navicular helmets which are clearly broader than tall. Next, species of subgenus Lycoctonum have tubular parts in the distal part of necatry blades (e.g., Lauener and Tamura 1979, fig. 1, except for *A. moschatum* and *A. fletcheranum*; Kadota 1999, fig. 3). On the other hand, nectary blades of *A. tanguticum* are not provided with tubular parts. I concluded that *A.*

tanguticum does not belong to subgenus Lycoctonum nor subgenus Aconitum. Here I propose subgenus Tangutica based on ser. Tangutica W.T.Wang (1979).

I have already pointed out that *A. zeravschanicum* Steinb. from Central Asia and *A. popovii* Steinb. & Schisch. ex Sipliv. from East Siberia have also perennial rootstocks (Kadota 1997). *Aconitum fletcheranum* G.Tayl. from East Himalaya has been considered to be a member of the subgenus Lycoctonum (Tamura 1966, 1995, Lauener and Tamura 1979, W.T.Wang 1979) because this species bears perennial rootstock (Fig. 5). However, nectary blades of *A. fletcheranum* are not provided with tubular parts (Tamura 1995, fig. 15, 9–10, Tamura and Lauener 1979, fig. 1B; Fig. 4C). *Aconitum fletcheranum* should be therefore classified into subgenus Tangutica. *Aconitum spiripetalum* Hand.-Mazz. from Sichuan Province, China, is characterized by having perennial rootstocks, navicular helmets and non tubular nectary blades and is also regarded as a member of the subgenus Tangitica.

Conducting field examination in Qinghai Province, China, I found *Aconitum* plants which were similar to but significantly different from *A. tanguticum*. After repeated field surveys and examination of herbarium specimens, I came to a conclusion that these plants belongs to a new species. The subgenus Tangutica is consequently consisted of the following six species: *A. fletcheranum*, *A. popovii*, *A. qinghaiense*, *A. spiripetalum*, *A. tanguticum* and *A. zeravschanicum*.

Aconitum moschatum (Brühl) Stapf described from Kashmir has been considered to be a member of subgenus Lycoctonum, since this species has perennial rhizomes (Stapf 1905, pl. 94, Tamura 1966, 1995, fig. 15, 11–12, Lauener and Tamura 1979, Tamura and Lauener 1979, fig. 1A, Chaudhary and Rao 1998). However, nectary blades of *A. moschatum* are not equipped with tubular portions. It is highly doubtful that *A. moschatum* belongs to subgenus Lycoctonum. This issue will be discussed elsewhere.

Subgenus **Tangutica** (W.T.Wang) Kadota, stat. nov.

Ser. *Tangutica* W.T.Wang, Fl. Reipubl. Pop. Sin. **27**: 604 (1979).

Sect. *Sinaconitum* auct. non W.T.Wang: Tamura, Natürl. Pflanzenfam. **17 a IV**: 284 (1995), p. p. minore.

Type species: *Aconitum tanguticum* (Maxim.) Stapf.

Distribution: W China, E Siberia and Central Asia.

Sect. 1. **Fletcherum** Tamura emend. Kadota.

Subgenus *Paraconitum* Rapaics sect. *Fletcherum* Tamura in Sci. Rep. Osaka Univ. **15**: 30 (1966)—Lauener & Tamura in Notes Roy. Bot. Gard. Edinb. **37**: 117 (1979)—W.T.Wang, Fl. Reipubl. Pop. Sin. **27**: 179 (1979)—Subgeus *Lycoctonum* (DC.) Peterm. sect. *Fletcherum* Tamura, Natürl. Pflanzenfam. **17 a IV**: 280 (1995).

Type species: *Aconitum fletcheranum* G.Tayl.

Herba parva perennis scaposa. Caulis simplex basi obtectus vestigiis fibris. Folia basales rosulatae laminis membranaceis ambitu reniformis profunde trilobatis, petiolis basi vaginatis. Flos solitarius terminalis. Cassis navicularis rostrio brevi obtuso. Calcaria nectariorum bacilliformia leviter incurvata. Labella nectariorum breves fimbris conspicuis auriculatis. Carpella 6–8.

1. Aconitum fletcheranum G.Tayl. in J. Roy. Hort. Soc. London **77**: 242 (1952)—Tamura in Sci. Rep. Osaka Univ. **15**: 30 (1966)—Lauener & Tamura in Notes Roy. Bot. Gard. Edinb. **37**: 117 (1979)—W.T. Wang, Fl. Reipubl. Pop. Sin. **27**: 179 (1979) —Gleason & Long, Fl. Bhutan **1**(2): 316 (1984)—Sharma, Fl. Ind. **1**: 13 (1993).

TYPE: BHUTAN: Pangotang, Tsampa,

alt. 14500 ft, 12 September 1949, perianth a very bright violet, a beautiful colour, with a striking white edge to the inner segments, on cliff ledges of steep gravery open slopes, F. Ludlow, G. Sherriff & J. H. Hicks 19734 (holotype–E!).

Distribution: SE Tibet, Bhutan and Assam.

Aconitum fletcheranum is characterized by having pedicels sparingly strigose with rough-surfaced curved hairs, scape base clothed with fibrous remains of petioles and nectary labia with auriculate flanges. Nectary spurs are less developed and show a degenerated condition (Fig. 4C). It is possible that they secrete no nectar. This should be investigated in the field.

Sect. 2. **Tangutica.**

Sect. *Sinaconitum* auct. non W.T.Wang: Tamura, Natürl. Pflanzenfam. **17 a IV**: 284 (1995), p. p.

2. Aconitum popovii Steinb. & Schisch. ex Sipliv. in Nov. Sist. Vyssh. Rast. **11**: 335 (1974)—Kadota in Natur. Environ. Sci. Res. **9**: 7, fig. 2-E (1996).

TYPE: RUSSIA; Central Siberia, 'Montes Sajan Orientalis, jugum Tunkense, fl. Chubuta, in prato temperate irrigito' [East Sayan Mountains, the Tunkinskyi Range], 11 July 1957, L. M. Malyshev & N. Misjura s. n. (holotype–LE!; isotypes–NS!).

Distribution: the Tunkinskyi Range, E Siberia (endemic).

Aconitum popovii is characterized by having pedicels villose with smooth-surfaced patent hairs and cup-shaped nectary spurs. As stated in Kadota (1996), *A. popovii* is discriminated from *A. tanguticum* by having cup-shaped nectary spurs and short but distinct emarginate labia.

3. Aconitum qinghaiense Kadota, sp. nov. [Figs. 1-3, 4A]

Aconitum tanguticum auct. non (Maxim.) Stapf: Kadota in Natur. Environ. Sci. Res. **11**: 2 (1996), p. p. minore (Forrest 14643 from Yunnan, K).

Differt ab *Aconito popovii* labellis nectariorum reflexis cum marginibus leviter auriculatis, cassidibus navicularis cum rostris longis; ab *A. tangutico* calcaribus nectariorum cupulatis, labellis nectariorum brevis sed manifestis.

A subscapose perennial, 10–30 (–70) cm tall. Rootstock branched into narrowly carrot-shaped tubers 1–3 cm long, ca. 5 mm in diameter. Stem terete, 1–2 times branched to simple. Basal leaves rosulate, subcoriaceous, roundish reniform, 3–4 cm long, 3.5–5 cm broad, medially (to 1/2 from the base) 5–9-lobed, glabrous on both sides; middle lobes broadly obovato-rhombic, 1–2 cm long and broad, coarsely dentate with obtuse teeth; petioles 5–8 cm long, glabrous, vaginate at base. Cauline leaves 2–3, pentagonal in outline, deeply trilobed with deeply incised lobes, glabrous, shortly petiolate. Flowers in July to August, pale greenish white or sometimes bright blue violet, 2–4 in a compact raceme, ca. 2 cm long and broad, sparingly strigose with rough-surfaced curved hairs. Pedicels erect, 5–10 mm long, strigose with rough-surfaced curved hairs; bracteoles linear, 5 mm long, 1 mm broad, situated around the middle of the pedicels. Helmets navicular with long attenuate beaks, 1 cm tall, 2 cm broad; lateral sepals broadly obovate, 17–18 mm long and broad, devoid of long pollen-collecting hairs on the adaxial side. Nectaries glabrous; spurs cup-shaped, erect, dark purple, ca. 2 mm long; labia ca. 1 mm long, dark purple, clearly bilobed, strongly reflexed, provided with slightly auriculate flange; claws slightly incurved, 12–14 mm long. Carpels 4–5, glabrous. Stamens glabrous or sparingly villose with smooth-surfaced patent hairs, provided with staminal teeth. Mature seeds unknown; immature seeds smooth and not lamellate across.

TYPE: CHINA; Prov. Qinghai, Xining,

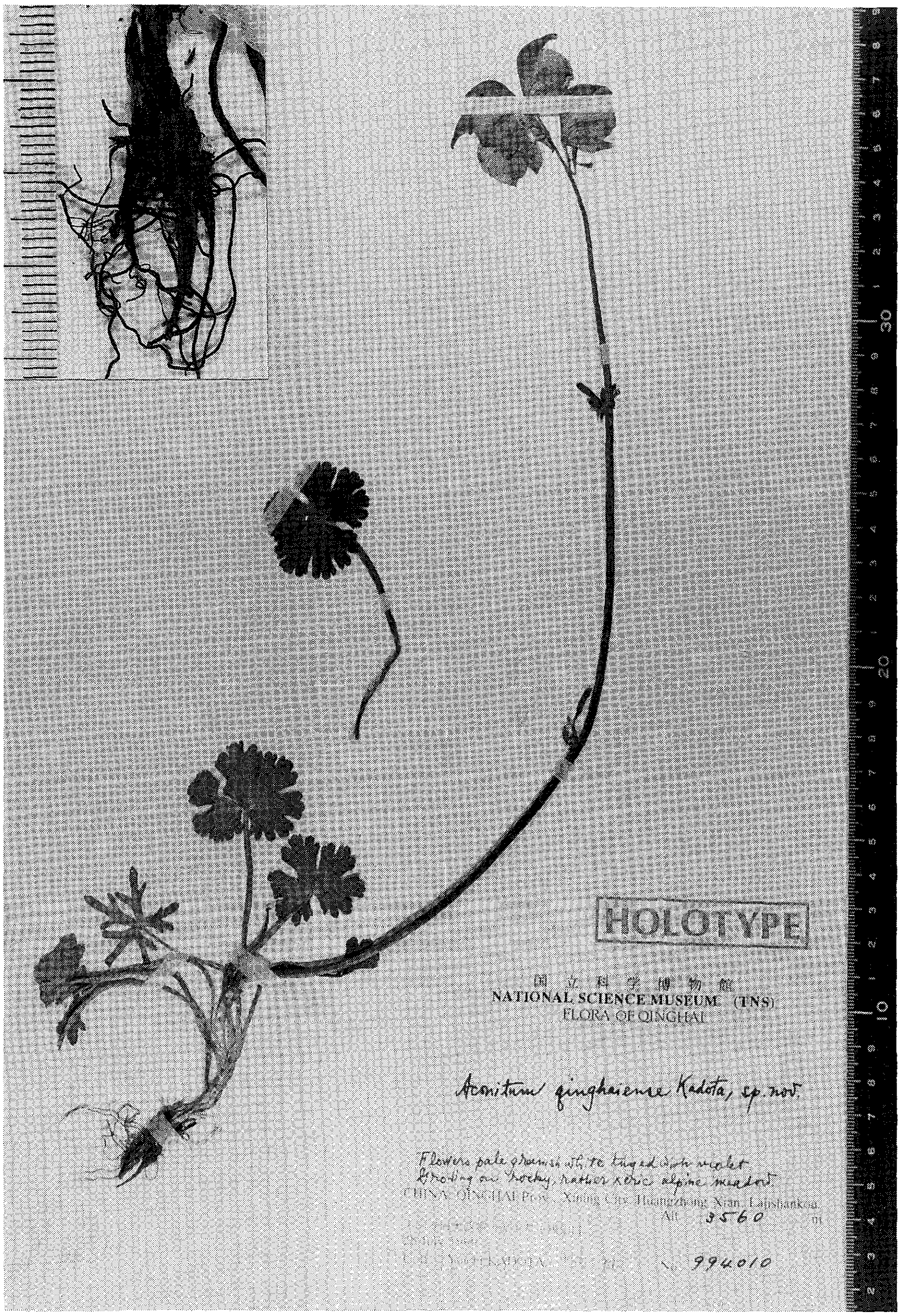
HOLOTYPE
国立科学博物館
NATIONAL SCIENCE MUSEUM (TNS)
FLORA OF QINGHAI
Aconitum qinghaiense Kadota, sp. nov.
Flowers pale greenish white tinged with violet
Growing on rocky, rather xeric alpine meadow.
CHINA: QINGHAI Prov., Xining City, Huangzhong Xian, Lajishankou
Alt. 3560 m
No. 994010

Fig. 1. Type specimen of *Aconitum qinghaiense* Kadota (CHINA; Prov. Qinghai, Xining, Huanzhong Xian, Lajishankou, alt. 3560 m, 28 July 1999, Y. Kadota 994010, holotype, TNS). The left corner inset shows a perennial rootstock (the same locality, Y. Kadota 994008, TNS).

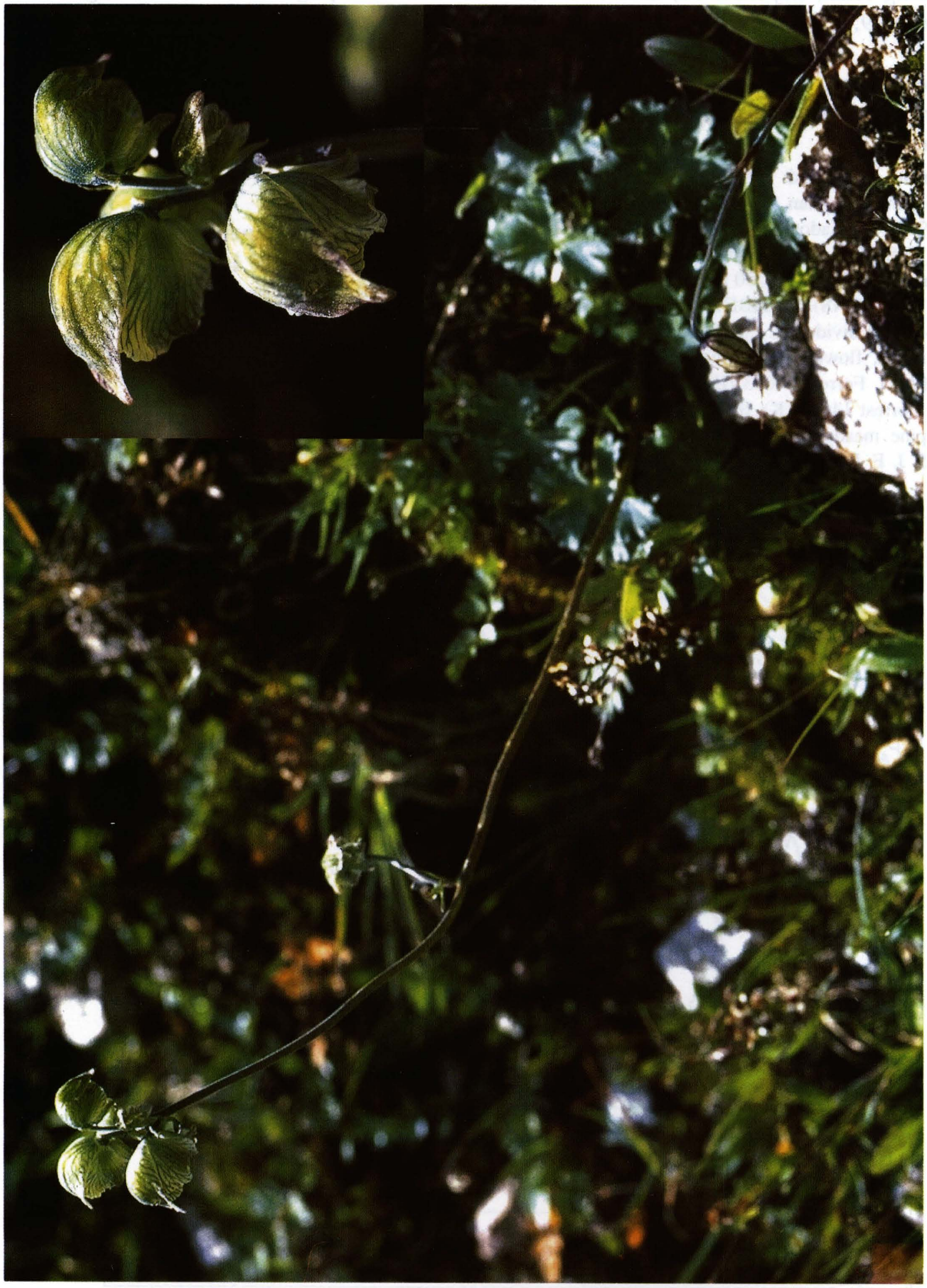

Fig. 2. Habit of *Aconitum qinghaiense* Kadota (CHINA; Prov. Qinghai, Xining, Huanzhong Xian, Lajishankou, alt. 3560 m, 28 July 1999).

Huanzhong Xian, Lajishankou, alt. 3560 m, 28 July 1999, Y.Kadota 994010 (holotype–TNS).

Chinese name: Qinghai-wutou (青海烏頭).

Distribution: E Qinghai, SE Tibet and SW Gansu (Fig. 3).

Specimens examined: CHINA; Prov. Qinghai, Xining, Huanzhong Xian, Lajishankou, alt. 3560 m, 28 July 1999, Y. Kadota 994004–994009, 994011–994012 (TNS); Prov. Qinghai, Hainan Tibetan Autom. State, Guide–Tongde, alt. 3750 m, 13 August 1991, Y. Kaodta 18016a (TNS). SE TIBET: Sarong, on Doke la, Mekong-Salwin divide, lat. 28°20′, alt. 13000 ft, plant of 2–3 inches, flowers deep blue, on stony pasture, Aug. 1917, G. Forrest 14673 (E); SE TIBET, 1917–1919, G. Forrest 14643 (K). SW GANSU: T'ao River basin, alpine meadow of Choni, alt. 9000–10000 ft, July 1925, J. F. Rock 12582 (LE).

Aconitum qinghaiense is distinguished from *A. popovii* by having reflexed nectary labia with slightly auriculate flanges and navicular helmets with long beaks, and discriminated from *A. tanguticum* by cup-shaped nectary spurs and short but distinct labia.

4. Aconitum spiripetalum Hand.-Mazz. in Acta Hort. Gothob. **13**: 91 (1939)—W.T. Wang, Fl. Reipubl. Popul. Sin. **27**: 184, pl. 33, figs. 7–8 (1979).

TYPE: CHINA: Sikang, Taofu (Dawo) Distr., Haitzeshan, in declioli herbosa-fruticoso, ca. 4200 m, 31 August 1934, H. Smith 11711 (holotype–WU!; isotypes–E!,

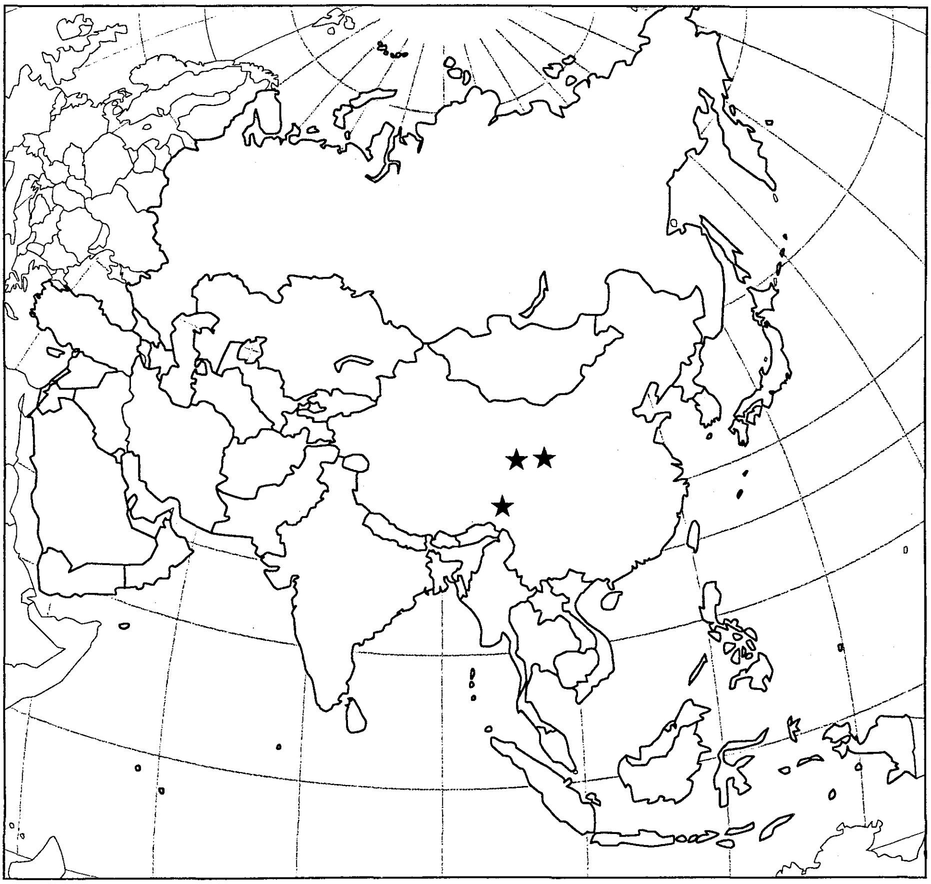

Fig. 3. Distribution of *Aconitum qinghaiense* Kadota.

PE!).

Distribution: W Sichuan (endemic).

Aconitum spiripetalum is characterized by pedicels strigose with rough-surfaced curved hairs and strongly coiled necatry claws, however, nectary spurs are basically similar to those of *A. qinghaiense*. Nectary labia of *A. spiripetalum* are projecting downward and entire while those of *A. qinghaiense* are clearly bilobed and reflexed (Figs. 4, A, B). Nectar secretion of *A. spiripetalum* was confirmed by me at Palanshan (alt. 4200 m), Prov. Sichuan, China, on 21 August 1996.

5. Aconitum tanguticum (Maxim.) Stapf in Ann. Roy. Bot. Gard. Calc. **10**: 51 (1905)—Hand.-Mazz. in Acta Hort. Gothob. **13**: 90 (1939)—Vorosch. in Byull. Glavn. Bot. Sada (Moskva) **64**: 33, 37 (1967)—Inst. Bot. Bor.-Occ. Acad. Sin., Fl. Tsinling. **1**: 261, fig. 223 (1974)—W.T.Wang, Fl. Reipubl. Popul. Sin. **27**: 182, pl. 33, figs. 1–4 (1979); Fl. Xizang. **2**: 22, fig. 5, 1–2 (1985)—Bot. Inst., Acad. Sin., Icon. Corm. Sin. **1**: 697, fig. 1934 (1980)—C.Y.Wu & al., Ind. Fl. Yunnan. 97 (1984)—Kadota, Himal. Pl. **1**: 215 (1988)—W.T.Wang & al., Vasc. Pl. Hengduan Mts. **1**: 455 (1993)—*Aconitum rotundifolium* Kar. & Kir. var. *tanguticum* Maxim., Fl. Tangut. 26 (1899)—Finet & Gagnep. in Bull. Soc. Bot. Fr. **53**: 213 (1905).

LECTOTYPE (Kadota 1998): CHINA: Terra Tangutorum [Prov. Gansu], Burchan Budda, alt. 13–15500 ft, 13 August 1884, fl. coeruleoviolacei, N.M.Przewalski 391 (LE!, Kadota 1998, fig. 1A; isotype–K!).

Distribution: Gansu, Qinghai, Shanxi, Sichuan, Yunnan and E Tibet.

Aconitum tanguticum is characterized by

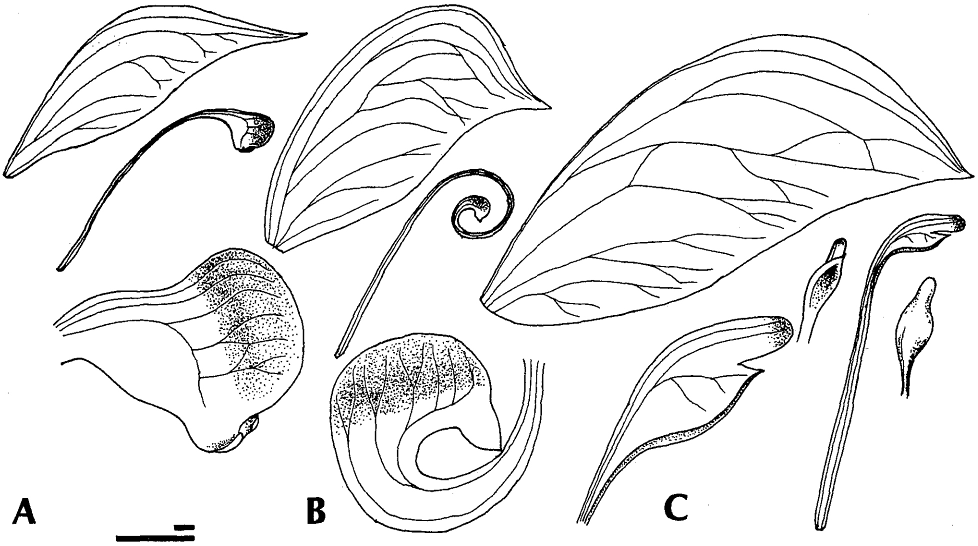

Fig. 4. Comparison in the spape of helmets and nectaries of *Aconitum* species. A. *A. qinghaiense* Kadota (CHINA: Prov. Qinghai, Hainan Tibetan Autom. State, Guide–Tongde, alt. 3750 m, 13 August 1991, Y. Kadota 18016a, TNS). B. *A. spiripetalum* Hand.-Mazz. (CHINA: Sikang, Taofu (Dawo) Distr., Haitzeshan, ca. 4200 m, 31 August 1934, H. Smith 11711, isotypes, E). C. *A. fletcheranum* G.Tayl. (BHUTAN: Pangotang, Tsampa, alt. 14500 ft, 12 September 1949, F. Ludlow, G. Sherriff & J. H. Hicks 19734, holotype, E). Scale 5 mm; short scale 1 mm for magnified nectary blades.

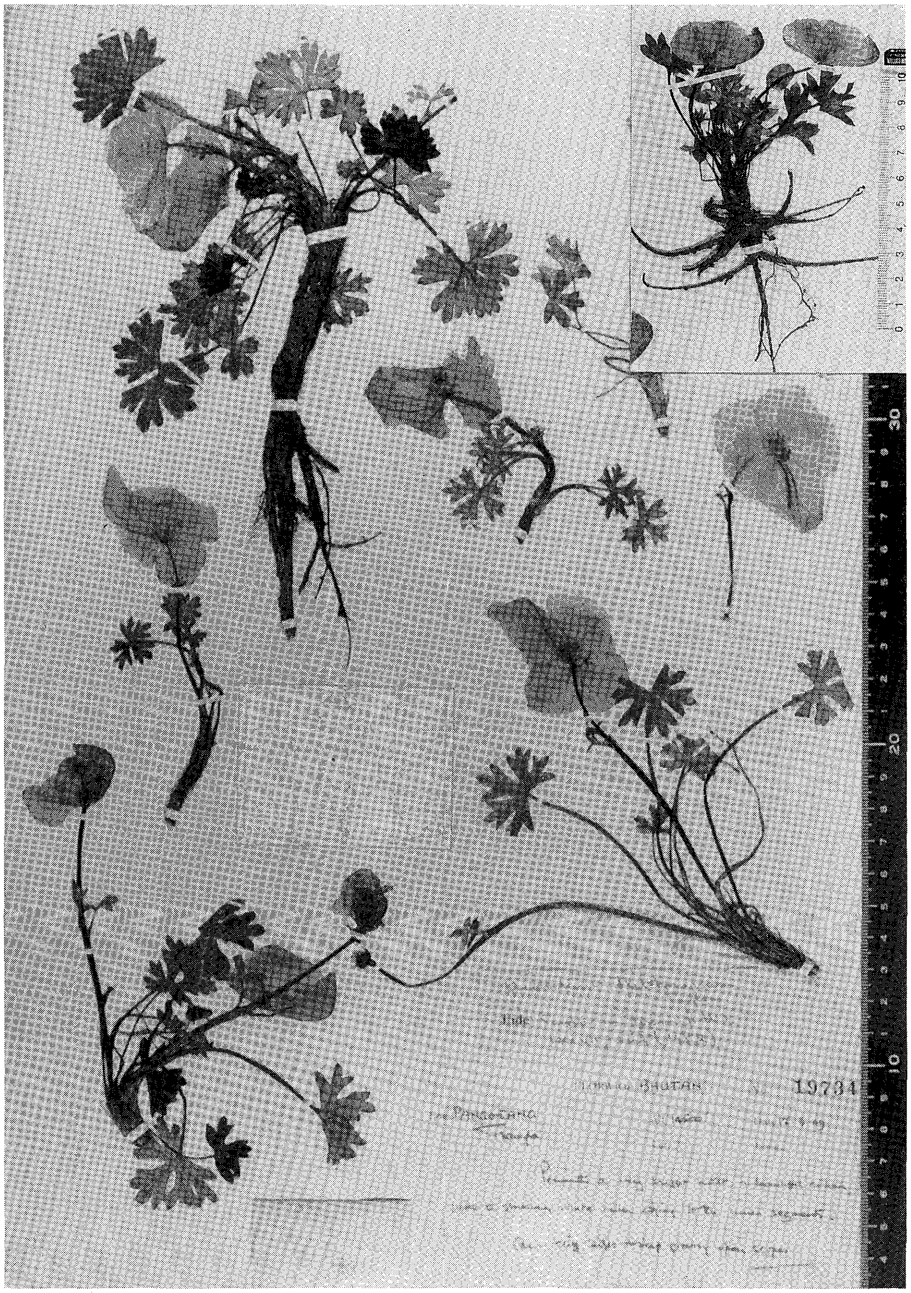

Fig. 5. Type specimen of *Aconitum fletcheranum* G.Tayl. (BHUTAN: Pangotang, Tsampa, alt. 14500 ft, 12 September 1949, F. Ludlow, G. Sherriff & J. H. Hicks 19734, holotype, E). The right corner inset shows a perennial rootstock (INDIA: Assam, Ze La, alt. ca. 15000 ft, 20 August 1938, F. Kingdon-Ward 14122, E).

having pedicels villose with flexuous hairs and slightly incurved, versatile nectary spurs with obscure labia. Nectar secretion of *A. tanguticum* was also verified by me at Balanshan (alt. 4400 m), Prov. Sichuan, China, on 22 August 1996. Refer to Kaodta (1998) for a detailed description.

Sect. **Zeravschanica** Kadota, sect. nov.

Herba mediocris perennis subscaposa. Caulis duplo vel triplo ramosum. Lamina foliorum coriacea ambitu rotundatae. Inflorescentiae racemosae. Cassides naviculares rostris brevibus obtusis. Calcaria nectariorum ellipsoidea labellis longis profunde bilobatis. Carpella 5. Semina rugosa non lamellata.

Type species: *Aconitum zeravschanicum* Steinb.

6. Aconitum zeravscahnicum Steinb., Fl. URSS **7**: 230, 733 (1937)—Butkov, Fl. Uzbek. **2**: 463 (1953)—Shpota, Fl. Kirghis. **6**: 60 (1955)—Wasylywa in Nov. Syst. Vyssh. **1966**: 243 (1966)—Kadota in Natur. Environ. Sci. Res. **9**: 6, fig. 2-D (1996).

TYPE: CENTRAL ASIA: Uzbekistan; 'N. slope of the Turkestan Range, Mt. Kurgansk near the source of the Au-korchegai River, among junipers, at the height of 2710 m', 2 August 1934, K. Afanatsev 424 (holotype–LE!).

Aconitum zeravschanicum is characterized by pedicels strigose with rough-surfaced curved hairs, whitish flower color and ellipsoidal nectary spurs with long bilobed labia. Nectar secretion of this species was confirmed by me at the Alaisky Range, Kirghistan, on 10 August 1995. Refer to Kadota (1996) for a detailed description.

Key to the species

1a. Nectary spur rod-shaped, slightly bending inwardly; nectary labium short, entire, provided with auriculate flange; scape clothed with fibrous remains of petioles (Sect. Fletcherum Tamura)..1. *A. fletcheranum*
1a. Nectary spur saccate, cup-shaped to ellipsoidal
  2a. Nectary spur ellipsoidal; labia long, conspicuously bilobed (Sect. Zeravschanica)...6. *A. zeravschanicum*
  2b. Nectary spur cup-shaped, slightly incurved or erect; labium short (Sect. Tangutica)
    3a. Nectary spur slightly incurved; labium obscure..........5. *A. tanguticum*
    3b. Nectary spur erect; labium short but obvious
      4a. Nectary stalk strongly coiling at proximal part; labium entire.................................4. *A. spiripetalum*
      4b. Nectary stalk slightly incurved; labium bilobed
        5a. Nectary labium not reflexed; helmet short beaked..2. *A. popovii*
        5b. Nectary labium reflexed; helmet long beaked.......................................3. *A. qinghaiense*

I wish to give my sincere thanks to Profs. W. T. Wang and Q. E. Yang for discussion, advice and suggestion on *Aconitum*; Mr. L. S.Wang, Kunming Institute of Botany, for his arrangement of the field work in Sichuan Province, China. My thanks also go to the curators of the Herbaria (BM, CAL, E, K, KATH, KUN, LE, MW, NS, PE, TI, TNS, W and WU). Field works were financially supported by the Grants-in-Aid from the Ministry of Education, Science, Sports, Culture and Technique, Japan (Nos. 07041151, 07041152). Herbarium works were supported by the Delegation Programs of the Japan Society for the Promotion of Sciences (1992, 1998) and the Program of Oversea Research Scholars from the Ministry of Education, Science, Sports, Culture and Technique, Japan (2000).

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門田裕一：アジア産トリカブト属（キンポウゲ科）の分類学的研究 VIII．第 4 の新亜属 Tangutica (W.T.Wang) Kadota とその 1 新種

Aconitum tanguticum (Maxim.) Stapf はチベット東部から雲南省，四川省などを経て陝西省にかけての地域に分布する中国固有の種である．標本ではしばしば地下部が失われているが，これはこの種が花茎状で，高山帯の岩混じりのやや乾いた風衝草原にはえるために植物体全体の採集が容易でないことが原因と考えられる．しかし，注意深く掘り出すことにより，分枝した多年生の貯蔵根をもつことが分かる．トリカブト亜属では貯蔵根は越年性であり，毎年更新される．したがって，*A. tanguticum* はトリカブト亜属の構成員ではないといえる．トリカブト属ではレイジンソウ亜属が多年生の貯蔵根をもつことで特徴付けられるが，*A. tanguticum* は上萼片（ヘルメット）が舟形であり，幅が高さよりも明らかに大きい．レイジンソウ亜属の種でも幅が高さよりも大きなものもあるが，この場合は花弁の舷部に円筒状の部分がある．*A. tanguticum* では花弁の舷部に円筒状の部分はない．このように，*A. tanguticum* はレイジンソウ亜属ともトリカブト亜属とも異なるので，Tangutica 節を亜属のランクに引き上げて subgenus Tangutica (W.T.Wang) Kadota とした．Tangutica 亜属はトリカブト属の中で 4 番目の亜属となる．

チベット東南部，アッサム，ブータンに分布する *A. fletcheranum* G.Tayl. も多年生の貯蔵根をもつことからこれまでレイジンソウ亜属に所属する種と考えられてきたが，*A. tanguticum* と同じように舟形で幅が高さより明らかに大きい上萼片と花弁の舷部に円筒状の部分がないことから，レイジンソウ亜属ではなく，Tangutica 亜属に属すると考えられる．*A. fletcheranum* はまた，花弁唇部の基部が耳状に広がる特異な花弁をもっている．そこで，単型的な節 sect. Fletcherum を認め，レイジンソウ亜属から Tangutica 亜属に移し，再記載を行った．同様に，キルギスタンとタジキスタンに分布する *A. zeravschanicum* Steinb. も花弁の距が楕円体状であり，唇部が大きくかつ 2 裂することから，トリカブト亜属から Tangutica 亜属に移し，単型的な節 sect. Zeravschanica を新設した．四川省固有の *A. spiripetalum* Hand.-Mazz. も多年生の貯蔵根をもつことを確認した．また，雲南省，青海省，甘粛省から *A. qinghaiense* Kadota を新種として記載した．*A. qinghaiense* は，東シベリア特産の *A. popovii* Steinb. & Schisch. ex Sipliv. とは明瞭に反曲する花弁唇部と嘴の長い上萼片をもつことで，*A. tanguticum* からは花弁の距がコップ状で短いながらも明瞭な唇部をもつことで区別される．したがって，新亜属 Tangutica は 3 節 6 種から成り，中アジア，東シベリア，東ヒマラヤ，中国横断山脈などチベット高原の周辺部に分布する．